

**LISTING OF CLAIMS:**

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Withdrawn) A spark plug (10) for an internal combustion engine, comprising:

a metal outer shell (12) having a central bore (37);

an insulator (36) secured within said central bore (37) of said shell (12);

a center electrode (25) mounted in said insulator (36);

a ground electrode (14, 114) extending from said outer shell (12) adjacent said central electrode (25) and defining a spark gap therebetween said ground electrode (14, 114) having an upper surface (38, 138) and a lower surface (40, 140) and a through hole (20, 120) located at said spark gaps, said through hole (20, 120) extending between said upper (38, 138) and said lower (40, 140) surfaces; and

a firing tip (18, 118) having a longitudinal axis, said firing tip (18, 118) being received at least in part in said through hole (20, 120) with said longitudinal axis extending towards said center electrode (25), and wherein said firing tip (18, 118) has a bulging portion (51, 151) extending radially outwardly from said longitudinal axis and mechanically retaining said firing tip (18, 118) within said through hole (20, 120); said bulging portion (51, 151) contained in said through hole (20, 120) between said upper (38, 138) and lower (40, 140) surfaces.

2. (Withdrawn) The spark plug of claim 1, wherein said firing tip (18, 118) is compressed axially along said longitudinal axis and said firing tip (18, 118) has a first length prior to being compressed and a second length after being compressed, wherein said second length is shorter than said first length.

3. (Withdrawn) The spark plug of claim 1, further comprising one or more weld joints between said ground electrode (14, 114) and said firing tip (18, 118).

4. (Withdrawn) The spark plug of claim 3, wherein at least one of said one or more weld joints is a resistance weld joint.

5. (Withdrawn) The spark plug of claim 3, wherein at least one of said one or more weld joints is a laser weld joint.

6. (Withdrawn) The spark plug of claim 1, wherein said firing tip (18, 118) has a pair of generally opposed ends with at least one of said ends having an enlarged head (48, 148) abutting a surface of said ground electrode (14, 114).

7. (Withdrawn) The spark plug of claim 6, wherein the other of said ends (46) of said firing tip (18) is generally flush with a surface (40) of said ground electrode (14).

8. (Withdrawn) The spark plug of claim 6, wherein the other of said ends (46, 146) of said firing tip (18, 118) is flared radially outwardly from said longitudinal axis upon compressing said firing tip (18, 118) to define a flared portion (50, 150) of said firing tip (18, 118).

9. (Withdrawn) The spark plug of claim 8, wherein said through hole (20) includes a counterbore (42) at one end, and wherein said flared portion (50) engages said counterbore (42) of said through hole (20).

10. (Withdrawn) The spark plug of claim 6, wherein said generally opposed ends of said firing tip (118) both have enlarged heads (146, 148) abutting one or more outer surfaces of said ground electrode (114).

11. (Withdrawn) A ground electrode (14, 114) for a spark plug comprising:  
a wire of a predetermined length having one end attached to a housing (12) of the spark plug (10) and having a second, free end (16), said wire having an upper surface (38, 138) and a lower surface (40, 140) and a through hole (20, 120) extending through said wire between said upper (38, 138) and said lower (40, 140) surfaces adjacent said free end (16); and

a firing tip (18, 118) having a longitudinal axis with said firing tip (18, 118) received at least in part in said through hole (20, 120), wherein said firing tip (18, 118) has a bulging portion (51, 151) extending radially outwardly from said longitudinal axis mechanically retaining said firing tip (18, 118) within said through hole (20, 120), said bulging portion (51, 151) contained in said through hole (20, 120) between said upper (38, 138) and lower (40, 140) surfaces.

12. (Withdrawn) The ground electrode of claim 11, wherein said firing tip (18, 118) is compressed axially along said longitudinal axis and said firing tip (18, 118) has a first length prior to being compressed and a second length after being compressed wherein said second length is shorter than said first length.

13. (Withdrawn) The ground electrode of claim 11, further comprising at least one weld joint between said ground electrode (14, 114) and said firing tip (18, 118).

14. (Withdrawn) The ground electrode of claim 11, wherein said firing tip (18, 118) has a pair of generally opposed ends with at least one of said ends having an enlarged head (48, 148) abutting a surface of said ground electrode (14, 114).

15. (Withdrawn) The spark plug of claim 14, wherein one of said ends (46) of said firing tip (18) is generally flush with a surface of said ground electrode (14).

16. (Withdrawn) The spark plug of claim 14, wherein the other of said ends (46, 146) of said firing tip (18, 118) is flared radially outwardly from said longitudinal axis upon compressing said firing tip (18, 118) to define a flared portion (50, 150) of said firing tip (18, 118).

17. (Withdrawn) The spark plug of claim 16, wherein said through hole (20) includes a counterbore (42) at one end, and wherein said flared portion engages said counterbore (42) of said through hole (20).

18. (Withdrawn) The spark plug of claim 14, wherein said generally opposed ends (34, 46, 134, 146) of said firing tip (18, 118) both have enlarged heads abutting one or more outer surfaces of said ground electrode (14, 114).

19. (Currently Amended) A method of constructing a ground electrode (14, 114) for a spark plug (10) comprising the steps of:

providing a segment of metal wire having an upper surface (38, 138) and a lower surface (40, 140);

forming a through hole (20, 120) in the wire, said through hole (20, 120)  
extending between and opening to each of said upper (38, 138) and lower (40, 140)  
surfaces;

providing a firing tip (18, 118) having a longitudinal axis;  
inserting the firing tip (18, 118) within the through hole (20); and  
compressing the firing tip (18, 118) in the direction of its longitudinal axis such  
that a first end (46, 146) of the firing tip (18, 118) flares outwardly from the longitudinal  
axis and a bulging portion (51, 151) is formed inside the through hole (20, 120) between  
the upper (38, 138) and lower (40, 140) surfaces of the wire.

20. (Original) The method of claim 19, including forming an enlarged head (48, 148) on a second end of the firing tip (18, 118) wherein the enlarged head (46, 146) abuts an outer surface of the wire upon inserting the firing tip (18, 118) within the through hole (20, 120).

21. (Currently Amended) The method of claim 19, further comprising forming a weld joint between the firing tip (18, 118) and the ~~material~~ metal wire.

22. (Original) The method of claim 21, wherein resistance welding is performed to construct the weld joint.

23. (Original) The method of claim 21, wherein laser welding is performed to construct the weld joint.

24. (Original) The method of claim 19, further comprising forming a counterbore (42) extending from at least one of the surfaces into the metal wire and wherein said compressing step further comprises compressing the firing tip (18) to cause the first end (46) to flare outwardly into the counterbore (42).

25. (Original) A method of making a spark plug, comprising the steps of:  
installing a center electrode assembly (24) within an insulator (36);  
providing a metal shell (12) having a central bore (37) sized to receive said insulator (36);

forming a ground electrode (14, 114) having a through hole (20, 120) adjacent one end thereof, said ground electrode (14, 114) having an upper surface (38, 138) and a lower surface (40, 140) with said through hole (20, 120) extending between and opening to each of said upper (38, 138) and lower (40, 140) surfaces;

inserting a firing tip (18, 118) having a longitudinal axis into said through hole (20, 120);

compressing said firing tip (18, 118) in the direction of said longitudinal axis until said firing tip (18, 118) undergoes deformation within said through hole (20, 120) at a location between said upper (38, 138) and lower (40, 140) surfaces;

attaching said ground electrode (14, 114) to said metal shell (12); and  
securing said insulator (36) and center electrode assembly (24) within said central bore (37) of said metal shell (12).

26. (Original) The method of claim 25, wherein said forming step further comprises forming said ground electrode (14) such that said through hole (20) has a counterbore (42) at a surface of the ground electrode (14).

27. (Original) The method of claim 26, wherein said compressing step further comprises compressing said firing tip (18) such that it flares out into said counterbore (42).

28. (Original) The method of claim 27, wherein said inserting step further comprises inserting a firing tip (18) having an enlarged head (48) until said head engages an outer surface of said ground electrode (14) opposite said counterbore (42).

29. (Original) The method of claim 25, wherein said compressing step further comprises compressing said firing tip (18, 118) such that it bulges outwardly within said through hole (20, 120) and deforms a center portion of said through hole (20, 120) outwardly, whereby said firing tip (18, 118) is mechanically interlocked to said ground electrode (14, 114).

30. (Original) The method of claim 25, further comprising the step of welding said firing tip (18, 118) to said ground electrode (14, 114).

31. (Currently Amended) The method of claim 25, wherein said providing step is carried out prior to said installing step.

32. (Withdrawn) A spark plug, comprising:

a metal shell (12) having a central bore (37);

an insulator (36) secured to said shell (12) within said central bore (37);

a center electrode assembly (24) extending through said insulator (36) and terminating at a firing end (32);

a ground electrode (14) attached to said shell (12) and having a free end (16) located adjacent said firing end (32), said ground electrode (14) having a through hole (20) open at both ends thereof and located adjacent said free end (16); and

a firing tip (18) extending from a first end to a second end (46) and having an enlarged head (48) at said first end;

wherein said firing tip (18) is disposed within said through hole (20) with said enlarged head (48) engaging an outer surface of said ground electrode (14), said enlarged head (48) being located opposite said firing end (32) of said center electrode assembly (24) to thereby define a spark gap between said enlarged head (48) and said firing end (32), said firing tip (18) having an expanded portion at said second end (46) that engages an outer surface of said ground electrode (14) such that said firing tip (18) is mechanically interlocked to said ground electrode (14) by said first and second (46).

33. (Withdrawn) The spark plug of claim 32, wherein engagement of said enlarged head (48) and said expanded section with said ground electrode (14) forms a first mechanical interlock of said firing tip (18) on said ground electrode (14), and wherein said firing tip (18) has a bulging portion (51) that extends radially outwardly within said through hole (20) and provides a second mechanical interlock of said firing tip (18) to said ground electrode (14).

34. (Cancelled).



35. (Withdrawn) The spark plug of claim 32, wherein said expanded portion of said firing tip (18) comprises a second enlarged head (46).

36. (Withdrawn) The spark plug of claim 32, wherein said firing tip (18) is welded to said ground electrode (14).